NEW SPECIES OF OSTRACODES FROM THE SILICA FORMATION (MIDDLE DEVONIAN) IN NORTHWESTERN OHIO[1, 2, 3]

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ABSTRACT

The Silica Formation of northwestern Ohio contains an abundant and diverse Ostracode fauna. This fauna was previously studied by Grace A. Stewart in 1936, at which time only the lower part of the formation was exposed. This study shows that the fauna is even more diverse than that described by Stewart. Five new species, *Hollinella attenuata*, *Halliella simplex*, *Nodella tetralobata*, *N. digitalis*, and *Primitiella multicostata*, are described.

INTRODUCTION AND STRATIGRAPHY

The Silica Formation of Middle Devonian Age is exposed in the quarries of the Medusa Cement Company located west of Sylvania, Ohio, and northwest of Silica, Ohio. The samples used in this study were obtained from the North Quarry located north of Brint Road and west of Centennial Road (Fig. 1). The Silica Formation contains an abundant and diverse ostracode fauna, which was studied in 1936 by Grace A. Stewart. At that time only the lower half of the formation was exposed. Subsequent exposure of the entire thickness now permits a more thorough sampling of this fauna.

The name "Silica Shale" was proposed by Grace A. Stewart in 1927. At that time, 23 feet of the formation from the base upward was exposed, but it was known that at least 45 feet were actually present, as indicated by cores. The original outcrop was located in the South Quarry of the Medusa Cement Company. The present exposure, in the North Quarry, consists of three benches developed by quarrying operations. The term bench is here used to refer to the vertical thickness of rock between the flat shelves of rock. The top bench (A) is composed of shale which is homogeneous, light gray in color, and contains little fossil material. A 3–5-foot exposure of the Ten Mile Creek Dolomite overlies this shale. Bench (B) includes limestone, fossiliferous fissile shale, bryozoan limestone, and "barren shale," a term which has been used to describe the homogeneous gray shale in bench (A). This term has also been applied to similar appearing shale in bench (B), but this shale is not truly "barren" in that it contains an abundant microfauna. Bench (C) consists of fossiliferous fissile shale and limestone (fig. 2). In general the shale within the Silica Formation is bluish-gray, soft, highly calcareous, and disintegrates rapidly on weathering. A considerable amount of iron sulfide is present in the form of marcasite concretions, and in certain instances replaces all or a portion of the shells of various fossil organisms (Stewart, 1927).

The Silica Formation was deposited during Middle Devonian time by the precipitation of calcium carbonate and deposition of clay in a large inland sea, which covered most of midwestern United States. Stewart (1927) states that the "Silica Shale" is Hamilton in age, as demonstrated by its abundance of fossils representative of that time.

The species described in this paper were collected in the course of research leading to a Master of Arts degree at Bowling Green State University. The sampling procedure consisted of collecting from one-foot intervals through the entire thickness of the formation. A channel sample of approximately five pounds was obtained from each interval. Forty-four samples were collected. All ostracode carapaces were extracted from these samples, identified to species where possible, and the number of specimens of each species noted.

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DESCRIPTION OF THE FAUNA

Thirty genera contained in 16 families were identified in this study. Of these, 17 genera and 12 families were previously described by Stewart (1936). A list of the species described by Stewart together with the additional species found in this study is contained in Table 1. The five new species are distributed among four genera and four families.

The total number of complete individuals collected in this study was 16,900. In a fauna as large as this one, the differentiation of previously described species and new species is much more reliable than in smaller faunas. Even though the new species described in this paper are founded on a relatively small number of

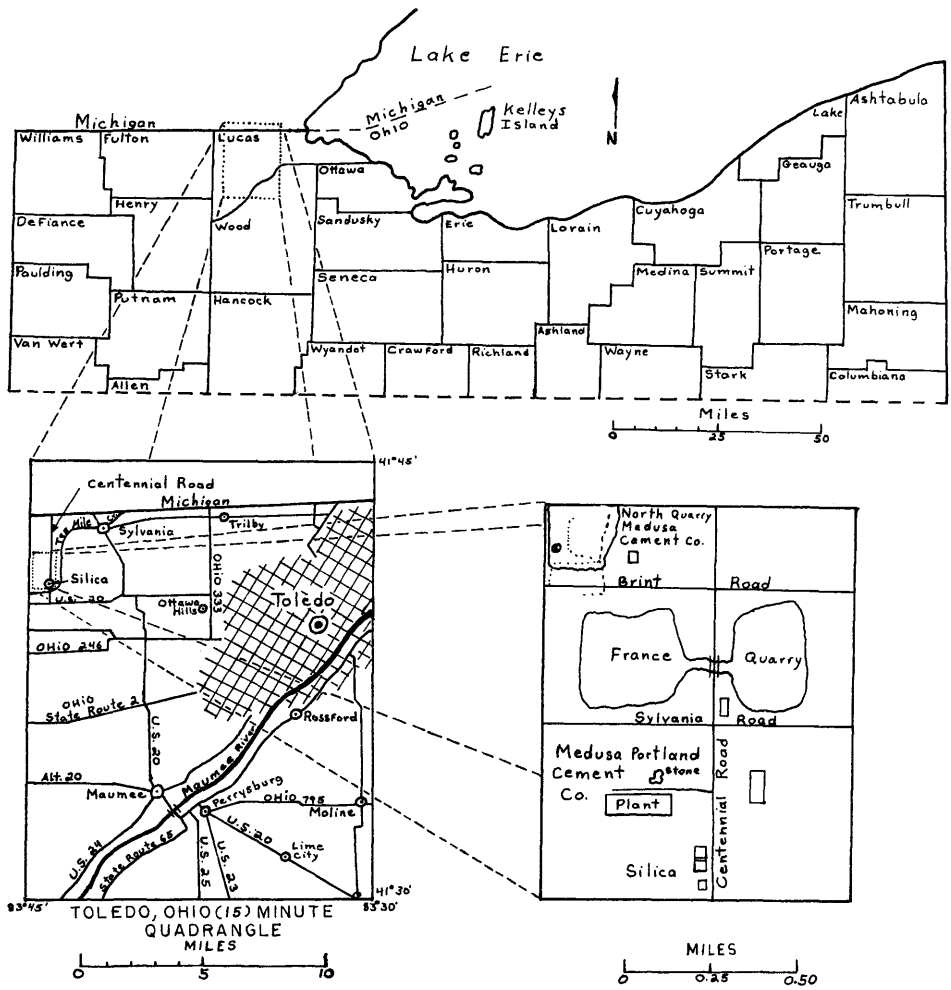


FIG. 1. Map showing the location of North Quarry, the quarry that yielded the samples o Silica Formation used in this study.

specimens compared to the rest of the fauna, no gradational forms, or instars, connecting these specimens to previously described species were detected. In addition, the specimens used to establish the new species showed little variation in size, volume, hinge thickness, or degree of ornamentation, characteristics which are common variables used in the determination of instars. Kesling (1953)

stated that some of the causes of variation within an ostracode species are (1) sex, (2) individual variation, (3) diet, (4) parasitism, and (5) temperature. Consequently, some variation is to be expected within a species and in a fauna this large the intraspecific variation was readily apparent for most of the species.

It is not the intent of the author to infer that all instars were recognized when encountered in the various species. If one could say that all species of ostracodes

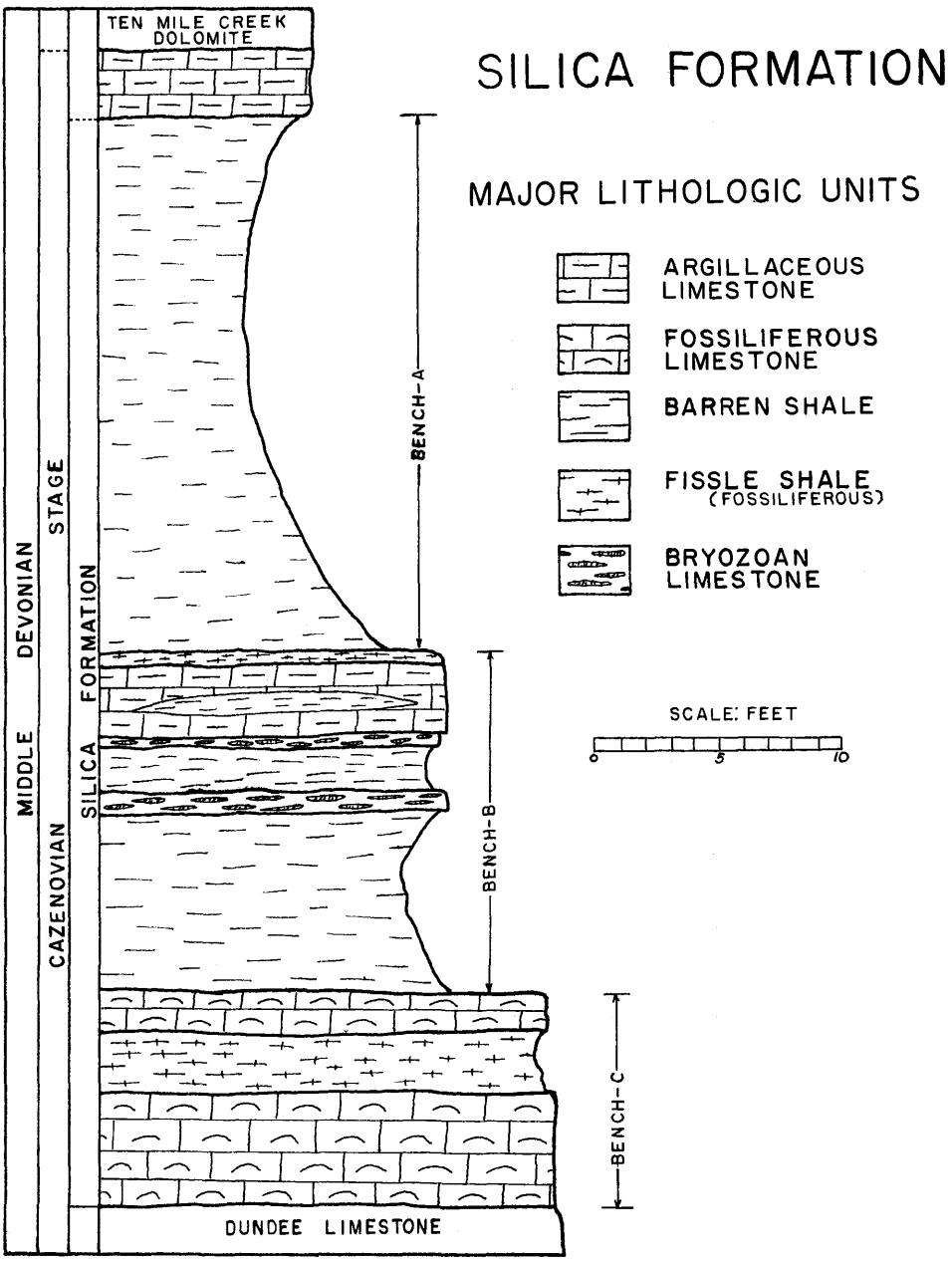


FIG. 2. Generalized Columnar Section of the Silica Formation in the North Quarry of the Medusa Cement Company near Silica, Ohio.

encountered in this study moulted on the average of five times in their life cycle, then one would intuitively expect to find the major portion of the fauna to be composed of instars. It was found that 75 per cent of the fauna consisted of adults, which is a somewhat high percentage considering the number of instars which should have been present. This observation is based on size criteria, degree of ornamentation, and the fact that many of the specimens had both valves hinged and closed. The apparent anamoly may have been due to some of the instars being interpreted as adult forms or to selective sorting and preservation. There was, however, no evidence to support the possibility of selective sorting or selective preservation, as all the specimens were in a very good state of preservation with no abrasion of the external features. Much work is yet to be done with the paleoecology of this abundant and diverse fauna.

TABLE 1

Composite list of the Ostracoda of the Silica Formation

Species described by Stewart (1936)	Additional species not described by Stewart (1936) reported here
Halliella bellipuncta	*Haliella simplex* sp. nov.
Aechmina serrata	*Nodella digitalis* sp. nov.
Ulrichia conradi	*Nodella tetralobata* sp. nov.
Ulrichia fragilis	*Aechminaria sp.*
Adelphobolbina trilobata	*Aechminaria hormathota*
Stenoloculina cicatricosa	*Falsipollex laxivelatus*
Tetrasacculus bilobus	*Falsipollex valgus*
Tetrasacculus bifidus	*Falsipollex parvilobatus*
Eukloedenella seriata	*Hollinella labrosa*
Poloniella cingulata	*Hollinella attenuata* sp. nov.
Dizygopleura oblonga	*Hollinella productilobata*
Paraparchites plana	*Hollinella senticosa*
Paraparchites scapha	*Parabolbina granosa*
Bythocypris sp.	*Arcyzona diadematus*
Menoeidina subreniformis	*Arcyzona campylactinota*
Menoeidina tumida	*Arcyzona homalosagenota*
Quasillites mundula	*Eukloedenella subaequalis*
Quasillites spinulifera	*Eukloedenella umbilicata*
Euglyphella sigmoidalis	*Primitiella multistriata* sp nov.
Bufina bicornuta	*Primitiella unicornis*
Octonaria quadricostata	*Healdia gibba*
Ponderodictya punctilifera	*Bairdiocypris gerolsteinensis*
	Bairdites sp.
	Quasillites obliquus
	Eriella robusta
	Jenningsina catenulata
	Euglyphella compressa?
	Bythocyproidea sanduskyensis
	Octonaria cresentiformis
	Octonaria laevilatata

SYSTEMATIC DESCRIPTIONS

Subclass Ostracoda
Order PALAEOCOPIDA Henningsmoen, 1953
Suborder BEYRICHICOPINA Scott, 1961
Superfamily Beyrichiacea Matthew, 1886
?Family **Beyrichiidae** Matthew, 1886
Genus *?Halliella* Ulrich, 1891

Halliella simplex sp. nov.
Pl. 1, fig. 9 & 10

Dimensions: (Dimensions for all species described here were derived from representative individuals) length, 0.80 mm.; height, 0.45 mm. Carapace of medium size, semielliptical with dorsal margin or hinge-line undulating. Surface smooth. A broad, compressed ventromedian ridge extends across the central three-fourths of the valve. The ventral border is crescent shaped and its dorsal border is straight. It originates in the posteroventral portion of the valve and

terminates in the anteroventral area about 0.08 mm. from the anterior margin. The termination is marked by a tapering and an elevation of the anterior end. An elliptical sulcus oriented with its axis dorsoventrally is in the dorsocentral region of the carapace. The ends of the valves are unequally rounded with the anterior being less round than posterior.

Discussion—Scott (1961) assigns the genus *Halliella* to the family Beryrichiidae with reservation; this taxonomic placement is adopted here. The carapace of *Halliella simplex* is larger than *H. bellipuncta* (Van Pelt), but not as elongate. The sulcus does not extend as far dorsoventrally, but is confined primarily to the dorsocentral portion of the valve. Only two valves were collected. The specimens were described as new species because they were larger and the sulcus was smooth instead of having reticulations as is typical of *H. bellipuncta* (Van Pelt). In addition, no instars linking *H. simplex* with *H. bellipuncta* were found. The name was derived from the fact that these specimens lack the degree of ornamentation found in other members of the genus *Halliella*.

Occurrence—The two valves were found in sample B–2.

Repository—Holotype, BGSU 562; Paratype, 563.

Superfamily Drepanellacea Ulrich & Bassler, 1923
?Family **Drepanellidae** Ulrich & Bassler, 1923
Genus *? Nodella* Zaspelova, 1952
Nodella digitalis sp. nov.
Pl. 2, fig. 9 & 10, 12 & 13

Dimensions: length, 0.48 mm.; height, 0.42 mm. Carapace evenly rounded except for dorsal margin which is straight. Ends are evenly rounded and taper on the anterior and posterior margins causing the valves to appear semielliptical.

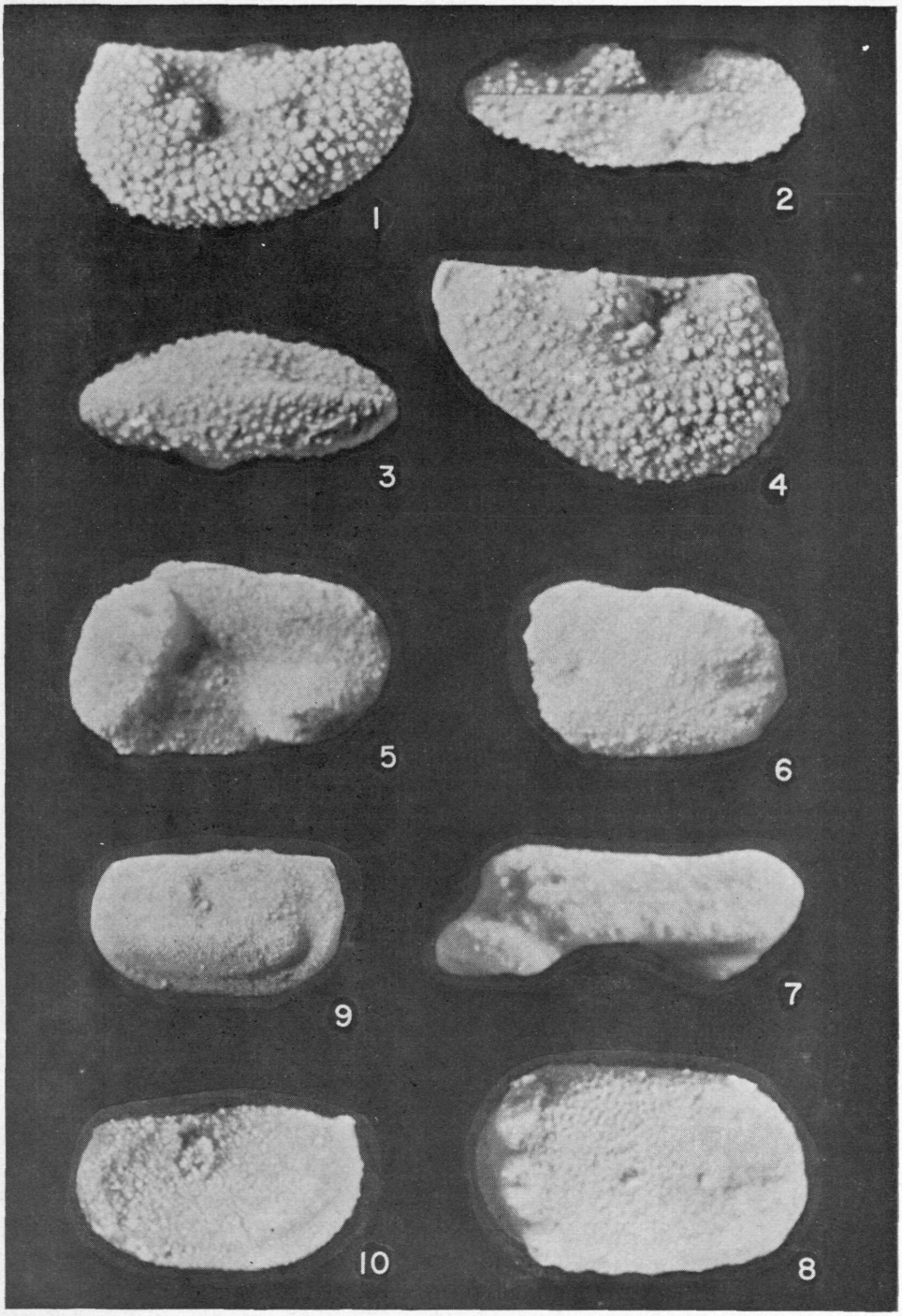
Both valves possess three spinose dorsal lobes, the largest located centrally and projecting about 0.1 mm. beyond the dorsal margin. The other two are located on either side of the large central lobe, and are separated from it by deep, uneven fissures on either side. The fissure associated with the anterior lobe is shorter than that associated with the posterior lobe. The surface is finely punctate.

Discussion—This genus is doubtfully placed in the family Drepanellidae which follows the work of Scott (1961). The right and left valves are equal in size and appearance. This species differs from *Nodella svinordensis* (Zaspelova) and other species of *Nodella* in that the valves are more evenly rounded, only the central lobe extends beyond the margin, the secondary lobes and fissures are unequal, the surface is punctate, and the ventral termination of the lobes is more pronounced. The name *digitalis* was selected because of the "digit-like" appearance of the lobes on each valve.

Occurrence—Seven valves have been found. The specimens were found in the upper fourth of bench (B) in samples one and two.

Repository—Holotype, BGSU 564; Paratype, 565, 566; Hypotype, 567.

EXPLANATION OF PLATE I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Nodella tetralobata sp. nov.
Pl. 2, fig. 6, 7, & 8

Dimensions: length, 0.42 mm.; height, 0.20 mm. Carapace evenly rounded and compressed dorsoventrally into an elongated ellipse. Valves nearly twice as long as high. Dorsal margin slightly rounded, with centrally located lobe extending slightly beyond it. Ends almost equally rounded, but posterior is more blunt. The ventral margin rises slightly anterior to the left edge of the central lobe, increasing the height of the valve in this area. Carapace is narrow in cross section.

Surface smooth except for a few punctate structures in the anteroventral region. There is one crescent-shaped ridge posterior to the central lobe. Anterior to the central lobe are two crescent-shaped ridges, the one nearest the central lobe being the most pronounced and least curved. Between the central lobe and the ridge anterior to it and on the anterior and posterior extremities of each valve are areas of well-developed pits. The pitted area between the lobe and ridge is circular in outline. Separating the two ridges and the central lobe are shallow grooves that originate on the dorsal margin and extend very close to the ventral margin.

Discussion—The assignment of these specimens to the genus *Nodella* is tentative in view of the present status of this genus. The specimens appear to have morphologic features best suited to this genus rather than any other in the family *Drepanellidae*. The carapaces are in good condition and show detailed structures. This species differs from the other species of *Nodella* described in this paper in that it is markedly more elongate, smaller, and very narrow in cross section. The curved lobes and the distribution of the punctae are also distinctive of this species. The trivial name was selected to draw attention to the four prominent elongate lobes.

Occurrence—Two valves and one complete specimen were collected at bench (B) in sample seven.

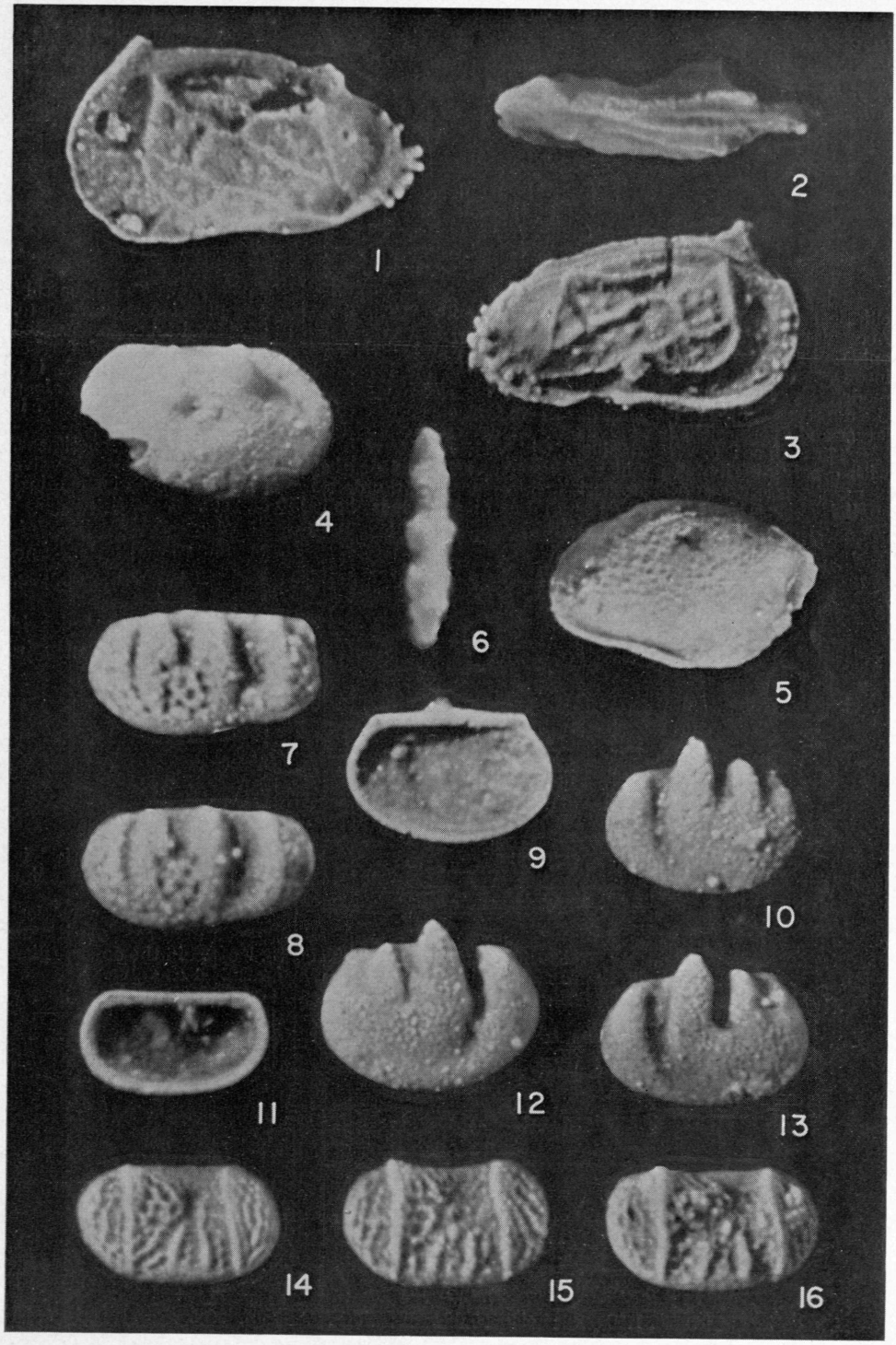
Repository—Holotype, BGSU 569; Paratypes, 570–572.

Family **Aechminidae** Bouček, 1936
Genus *Aechminaria* Coryell & Williamson, 1936
Aechminaria sp.
Pl. 2, fig. 4

Dimensions: length, 0.82 mm.; height, 0.62 mm. Valves of medium size, unequally rounded with anterior end more acuminate than posterior. Anterior and posterior margins are tapered.

Two thick spines are present on each valve. The anterior spine terminates in a sharp point and projects at about a 70-degree angle outward from the anterodorsal portion of the carapace. The posterior spine is not as well developed and is somewhat broader at its base.

EXPLANATION OF PLATE II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Discussion—Although two lobes are present, this specimen is arbitrarily placed in the genus *Aechminaria* which characteristically has only one centrally located lobe. The size, shape, general appearance of the carapace, and the fact that this specimen and *A. robusta* (Coryell and Williamson) both have a prominent pit suggests that this feature may indicate an affinity of this specimen for this genus.

Occurrence—One valve was collected from sample C–6.

Respository—Figured specimen, BGSU 568.

Superfamily Hollinacea Swartz, 1936
Family **Hollinidae** Swartz, 1936
Genus *Hollinella* Coryell, 1928
Hollinella attenuata sp. nov.
Pl. 1, fig. 1–4

Dimensions: length, 1.17 mm.; height, 0.80 mm.; and width, 0.45 mm. Carapace subelliptical with a slightly concave dorsal hinge-line. The dorsal end is prominently attenuate. According to Kesling's (1951b) terminology, L_1 is a very compressed, broad lobe, accentuated only on its posterodorsal margin. L_2, just above and anterior to L_1, is smaller and extends further into S_1 which is a broad groove at the hinge-line, but is constricted between L_2 and L_3. L_3 is a moderately-sized bulb tangent to the hinge-line, and in some specimens is elongated slightly along the dorsal margin. S_2 is a shallow groove that curves posteriorly around L_3. The right valve is larger and overlaps the left valve on the anteroventral and dorsal margins.

The surface is coarsely papillose, with widely scattered papillae around L_3 on some specimens, with evenly distributed papillae on others. Marginal denticles are present on the right valve of most specimens and are especially prominent on the dorsal margin. The anterior cardinal angle is about 115 degrees; the posterior cardinal angle is about 110 degrees.

Discussion—This species differs from *Hollinella pumila* (Kesling) and *Falsipollex parviolobatus* (Kesling) in that the valves are prominently attenuate, no velate structure or marginal spurs are present, and the papillae are very coarse. The name is derived from the shape of the carapace.

Occurrence—Nine specimens were collected from bench (B). This species is restricted to the lower third of bench (B) where it occurred most abundantly in sample B–10.

Repository—Holotype, BGSU 606; Paratypes, 607, 608.

Suborder KLOEDENELLOCOPINA Scott, 1961
Superfamily Leperditellacea Ulrich & Bassler, 1906
Family **Leperditellidae** Ulrich & Bassler, 1906
Genus *Primitiella* Ulrich, 1894
Primitiella multicostata sp. nov.
Pl. 2, fig. 11, 14–16

Dimensions: length, 0.48 mm.; height, 0.32 mm. Carapace very small, subelliptical in lateral view with a somewhat concave dorsal outline. The internal view shows that the hinge-line is straight. Cardinal angles are about 115 degrees.

Ornamentation consists of reticulations and costae. There are two prominent vertical costae about one-third of the length from each end of each valve. Secondary costae originate near the center of the ventral margin and extend toward a sulcus, S_2, located in the dorsomedian area of each valve. Well-developed reticulations occupy the remainder of each valve.

Discussion—Only single right and left valves were collected. These specimens are assigned to this genus on the basis of their size, shape, and marginal characteristics. The complexity of the costae distinguishes them from *Primitiella constricta* (Ulrich). The trivial name was selected to draw attention to the unusual nature of the costae.

Occurrence—Four complete valves of this species were collected, in sample B–9.

Repository—Holotype, BGSU 660; Paratypes, 661–663.

Order PODOCOPIDA Müller, 1894
Suborder METACOPINA Sylvester-Bradley, 1961
Superfamily Quasillitacea Coryell & Malkin, 1936
?Family **Quasillitidae** Coryell & Malkin, 1936
Genus *?Euglyphella* Warthin, 1934
Euglyphella compressa? (Coryell & Malkin)
Pl. 2, fig. 1–3

Dimensions: length, 1.10 mm.; height, 0.60 mm.; width, 0.38 mm. Carapace subtriangular

and tapering markedly toward the posterior end. Dorsal margin slightly convex, ventral margin straight, or slightly concave. Greatest height posterior, with a broadly rounded posterior margin and a narrowly rounded anterior margin.

Right valve larger and overlaps left valve along hinge-line. Hinge-line is straight and is grooved to fit the left valve. Along the posterodorsal margin of the right valve, the carapace forms a short, triangular protrusion that is directed dorsally in the plane of commissure. An anterior rise is similar to the posterior one, except that it is less prominent and more rounded.

The surface of each valve is ornamented with numerous narrow ridges. The outline of this system of ridges forms a rectangular shape whose posteroventral corner is broadly rounded. The posterodorsal corner is formed by the ridge becoming thicker and recurving to form a peak directed toward the posterodorsal margin extension. From this peak the dorsal ridge becomes very weak in the centerodorsal region and increases in prominence toward the anterodorsal corner, where it again thickens and forms another peak which is not as sharp as the one previously described. The anterior ridge makes an angle of about 95 degrees with the dorsal ridge at the peak, and drops slightly anteroventrally toward the anteroventral corner which is incompletely closed in most specimens. There is a weak ridge paralleling the ventral margin and connecting the other two corners of the rectangular outline of ridges.

Inside the rectangle are two parallel undulating ridges, about 0.1 mm. apart, running diagonally from the posterodorsal to the anteroventral corner where they terminate at the anteroventral margin. These diagonal ridges broaden and intersect a short ridge connecting them in the center to form an incomplete sulcus.

Along the anterior margin of each valve are six or seven elongate unevenly spaced marginal tubercles, which tend to extend directly outward in an anterior direction in front of the margin. About eight short tubercles are located very close to and paralleling the dorsal margin of each valve.

Discussion—Three species which *Euglyphella compressa?* resembles are *E. sigmoidalis* (Sohn), *E. compressa* (Coryell and Malkin), and *E. asapha* (Stover). This species has the general shape of *E. sigmoidalis* but is less elongate. Also *E. sigmoidalis* has its ridges interconnected in a sinuous pattern, which is unique to that species. *E. asapha* more closely resembles *E. compressa?* but has a very deeply concave central dorsal ridge, which has its maximum concavity just above the central pit. The parallel ridges are also lacking in *E. asapha*. *E. compressa* most closely resembles *E. compressa?* on the basis of its shape and arrangement of major ridges. Important differences are the more completely interconnected system of ridges on *E. compressa?*, the posterior ridge on *E. compressa* which does not end posterodorsally in a thickened peak, and the anterior extension of the centrodorsal ridge in *E. compressa?* which forms the two prominent triangular extensions of the dorsal margin. A statistical evaluation of the variation in the ridge ornamentation of a large number of specimens from each collection may show *E. compressa?* and *E. compressa* to be the same species.

Occurrence—Specimens were abundant and restricted to bench (C). Among samples 2, 3, 4, and 7, they were most abundant in sample number 3, where 10 specimens were collected.

Repository—Figured specimens, BGSU 715–717; unfigured specimen, BGSU 718.

Superfamily Healdiacea Harlton, 1933
Family **Bairdiocyprididae** Shaver, 1961
Genus *Bairdites* Coryell & Malkin, 1936
Bairdites sp.
Pl. 2, fig. 5

Dimensions: length, 1.00 mm.; height, 0.90 mm., width, 0.45 mm. Carapace shaped like *Bairdiocypris* in lateral view. Right valve overlaps left valve on all but the dorsal margin. The left valve is strongly pitted around a dorsocentral sulcus, whereas the right valve is less strongly pitted.

Discussion—These specimens could not be accurately described because they appeared to be somewhat distorted. However, if more specimens were collected which showed the same marginal and hinge characteristics, they might then be interpreted as new species.

Occurrence—Two specimens were collected from the lower part of bench (A), in sample numbers 16 and 18.

Repository—Figured specimen, BGSU 683; Unfigured specimen, 682.

Incertae sedis

Pl. 1, fig. 5–8

Dimensions: length, 0.82 mm.; height, 0.50 mm.; width, 0.30 mm. In the course of this study, about 25 specimens, all having the same shape and ornamentation as those illustrated, were collected. For descriptive purposes, the flat surface illustrated in Plate 1, Figure 8 will be referred to as dorsal, Figure 5 ventral, and the left end of Figure 7 anterior. Upon preliminary observations, these specimens appeared to have the shape of ostracodes; however, they lacked evidence of a hinge line, which is a prerequisite for assignment to this group. The possibility of these ossicles being otoliths or echinoderms was investigated. The type of organism having the closest morphological similarity to these ossicles was a starfish described in Piveteau (1953, p. 816).

Viewing the ossicle dorsally, the sides are straight with rounded ends. A shallow depression is located centrally on the posterior end with its axis oriented anterodorsally. On the anterior end are three pustule-like structures whose function is not known. These structures continue along the sides where there are four or five more making a total of 14 to 16 on the whole ossicle.

Ventrally, there is a "sucker-like" structure which is nearly as wide as the anterior width of the ossicle and projects anteroventrally away from the plane of the ventral surface making an angle of about 45 degrees. A broad spine is present posteroventrally and can be seen in the lower right portion of the ossicle shown in Plate 1, Figure 5. The exterior surface of the ossicle is finely granular. Some thin sections of these ossicles were cut from a number of specimens and they appear to be structureless casts of crystalline calcite.

Occurrence—Specimens were collected from the base of bench (A), top of bench (B), bottom of bench (B), and middle of bench (C). They were found most abundantly in the middle of bench (C).

Repository—Figured specimens, BGSU 728–731.

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